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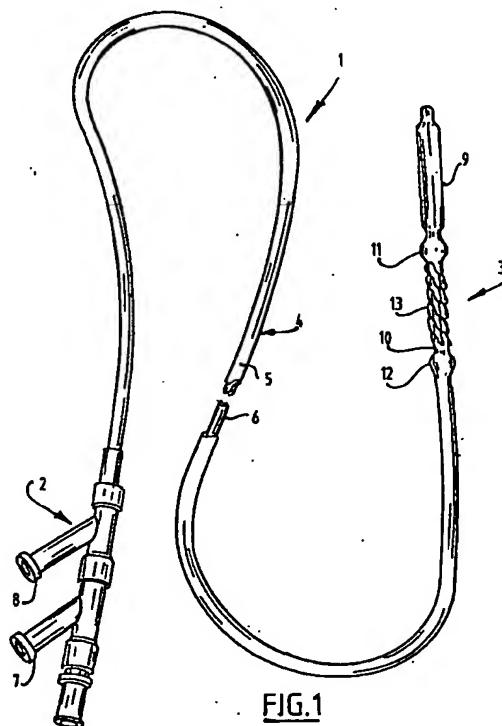
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(54) **Balloon catheter with several balloons**

(57) The invention relates to a catheter comprising a tube-like basic body with a proximal and a distal end and at least two balloon members arranged close to the distal end which are connected via lumens in the basic body with connecting members at the proximal end. The balloon members possess varying degrees of pliability. The different degrees of pliability are a result of the fact that the wall thickness of the balloon members varies.



EP 0 707 864 A1

## Description

The invention relates to a catheter with several balloons. Each of these balloons can be expanded separately by supplying medium under pressure via an appropriate lumen in the tube-like basic body of the catheter to the balloon in question.

A catheter of this type is for instance known from the European patent specification 0 260 107. The catheter described therein comprises several dilatation balloons of increasing diameter.

Another known catheter of this type with two balloons has been described in the American patent specification 5 226 889. The relatively distal balloon is in this case a dilatation balloon, whereas the relatively proximal balloon is used for expanding a stent. This stent is arranged in compressed state around the relatively proximal balloon and thus introduced into the body of the patient. By expanding the balloon, the stent, which will subsequently remain behind inside the body of the patient, will also expand.

Other types of catheters with several balloons comprise for instance an occlusion balloon as relatively distal balloon and a dilatation balloon as relatively proximal balloon.

The object of the invention is to provide a catheter of the type as described in the preamble, whereby each balloon has optimal properties for the intended use. As a result it will for instance be possible to make a dilatation balloon of a catheter more pliable than a balloon used for the purpose of fitting a stent. The greater pliability of the dilatation balloon allows for the application of a more uniform load on the wall of the vessel to be dilated, whereas for expanding a stent on the other hand a uniform expansion of the stent is more desirable than the application of a uniform load. This is achieved by making the balloon concerned less pliable.

A suitable embodiment is characterised in claim 2. The material of which the different balloon members have been made can be the same, whereby the required variation in pliability is achieved by employing different degrees of wall thickness.

Another suitable possibility is characterised in claim 3.

The invention is particularly suited for application with a catheter of the type which is to be used for the implantation of a stent, as has been mentioned above.

A further development is characterised in claim 5. A balloon member with a greater pliability will in general be used at lower pressures than a less pliable balloon member. Consequently great operational safety of the catheter according to the invention is achieved by employing the measure as set out in claim 5.

In the example of the catheter used for stent implantation, the relatively distal balloon is used, as has been mentioned before, for dilatation and requires less operating pressure than the relatively proximal balloon. The operating pressure of the dilatation balloon lies between

8-10 bar. The operating pressure of the balloon used for expanding the stent lies for instance between 14-16 bar.

In addition to the methods for realising the different degrees of pliability of the different balloon members mentioned already, the desired degrees of pliability in the different balloon members can also be achieved by employing suitable manufacturing processes.

The invention will be explained in greater detail in the following description with reference to the attached drawings.

Figure 1 shows a partly broken away perspective view of a catheter according to the invention.

Figure 2 shows a partly cut away view of the distal end of the catheter of fig. 1.

Figure 3 shows a view corresponding to figure 2 during the second step of the treatment.

The catheter 1 shown in figure 1 comprises a tube-like basic body 4, which in this case has been made up of an outer tube-like element 5 and an inner tube-like element 6 received in a lumen thereof. The inner tube-like element 6 has two lumens 16, 17. With the embodiment shown, two balloon members 9, 10 have been arranged at the distal end 3 of the catheter 1. At the proximal end 2, two connecting members 7, 8 have been arranged which are connected to the balloon member 9 and the balloon member 10 respectively. By supplying medium under pressure via the connectors 7 or 8, the balloon members 9 or 10 can be expanded. The connection between the connecting member 7 and the balloon member 9 runs via the lumen 17 of the inner tube-like element 6 and the connection between the connecting member 8 and the balloon member 10 runs via the interspace 20 between the inner tube-like element 6 and the outer tube-like element 5. The lumen 16 is for receiving a guide wire.

A compressed stent 13 has been arranged around the balloon 10. The stent 13 is enclosed in axial direction on the catheter 1 by bulges 11 and 12, so that it cannot slide off the balloon 10.

As will be explained in greater detail below, the balloon member 9 is used for dilating a narrowed blood vessel and the balloon 10 for expanding the stent 13. According to the invention the balloons 9 and 10 possess different degrees of pliability. More in particular, the dilatation balloon 9 is more pliable than the balloon 10 used for expanding the stent 13.

During treatment, the catheter 1 is first advanced into the blood vessel 18 that far, that the first balloon 9 is situated at the narrowed section of the vessel to be dilated. Next a medium under pressure is supplied via the connecting member 7 and through the lumen 17 of the inner tube-like element 6. This medium under pressure flows via the opening 21 in the wall of the inner tube-like member into the balloon 9, which will expand as a result. Consequently the blood vessel 18 will be dilated (fig. 2).

Because of the relatively great pliability of the balloon 9, it will adapt well to the shape of the blood vessel 18, so that the latter is subjected to a uniform load when being dilated.

Subsequently one allows the pressure inside the balloon 9 to drop, as a result of which it will regain its original shape. The catheter is advanced further into the body, until the balloon 10 will be positioned in the dilated section of the vessel. By now supplying medium under pressure to the balloon 10 via connector 8 and the interspace in between the tube-like elements 5, 6, which interspace is connected at the end of the outer tube-like element 5 in the form of a ring-shaped opening 20 with the inside of the balloon 10, this balloon 10 and consequently the stent 13 will be expanded. This situation has been illustrated in figure 3.

As said before, the balloon 10 is less pliable. The expansion is therefore less determined by possible resistance, so that a uniform expansion of the stent is achieved.

Next one allows the pressure in the balloon 10 to drop again, as a consequence of which the balloon 10 regains its original shape with small diameter. The catheter can now be withdrawn whereby the stent 13 remains behind in the blood vessel 18 in order to support the wall thereof.

The invention is not limited to application with a catheter for stent implantation. Other catheters with more balloon members, like for instance dilatation catheters comprising several dilatation balloons with different diameters, or dilatation catheters with occlusion balloon et cetera, can in a suitable manner be embodied according to the invention.

#### Claims

1. Catheter comprising a tube-like basic body with a proximal and a distal end, at least two balloon members arranged close to the distal end which are connected with connecting members at the proximal end via lumens in the basic body, wherein the pliability of the balloon members varies.
2. Catheter as claimed in claim 1, wherein the different degrees of pliability are a result of the fact that the wall thickness of the balloon members varies.
3. Catheter as claimed in claim 1, wherein the different degrees of pliability are a result of the fact that the balloon members have been manufactured of different materials.
4. Catheter as claimed in one of the previous claims, of the type intended to be used for the implantation of a stent, wherein a relatively distal balloon member is more pliable than a relatively proximal balloon member which is used for the purpose of expanding the stent.

5. Catheter as claimed in one of the previous claims, wherein the less pliable balloon member has a greater pressure resistance than the more pliable balloon member.

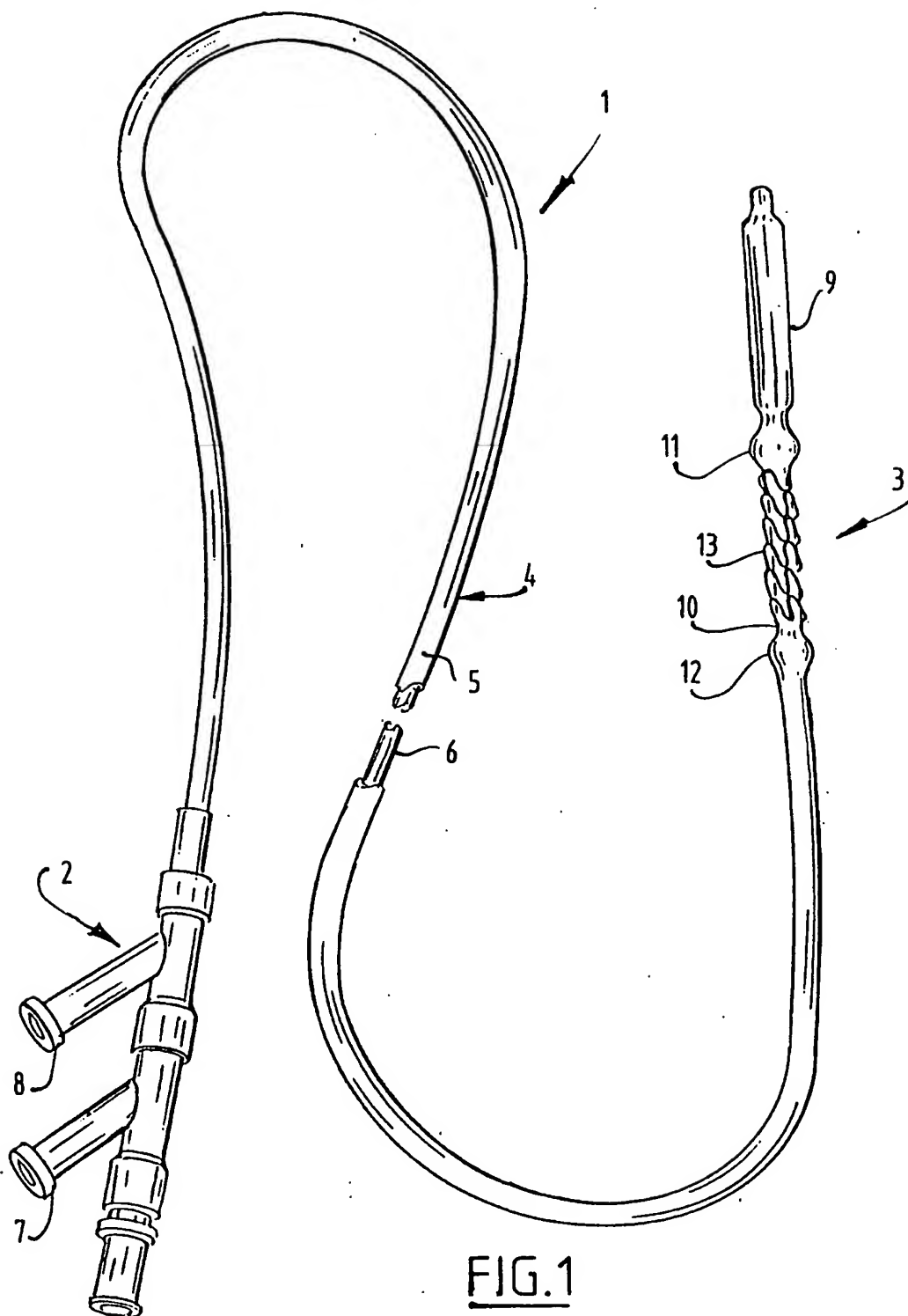


FIG.2

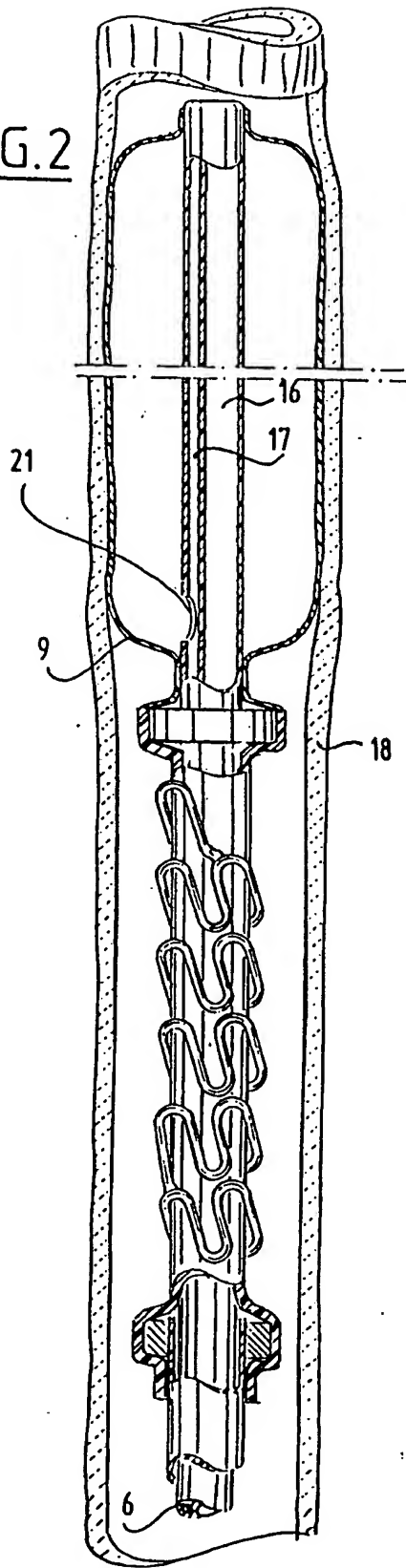
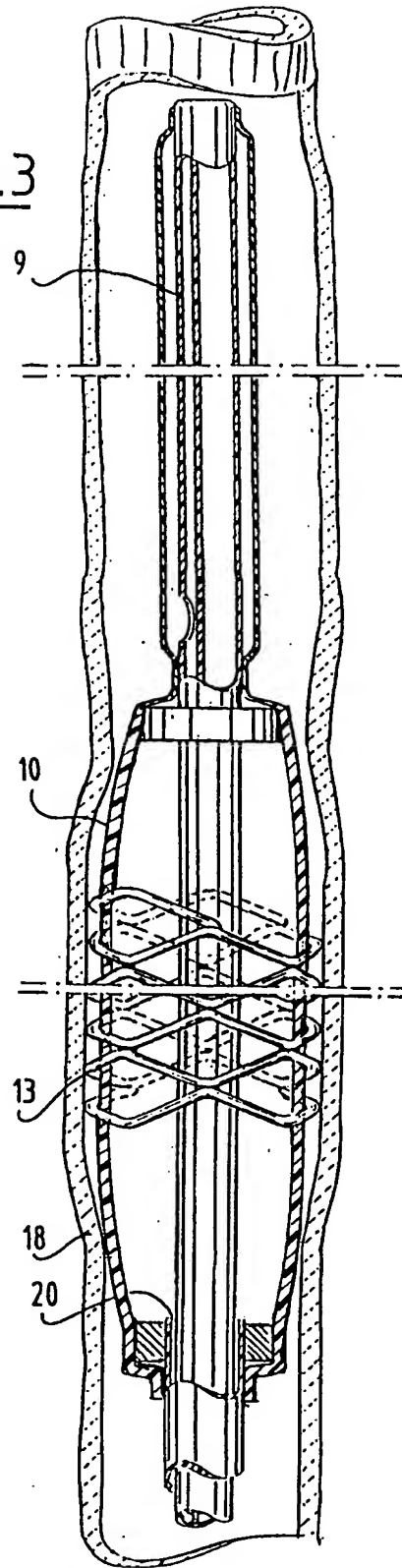


FIG.3





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## EUROPEAN SEARCH REPORT

Application Number  
EP 95 20 2755

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 345 051 (ADVANCED SURGICAL INTERVENTION) 6 December 1989 * column 6, line 42 - column 7, line 62; figures 11-14 *	1-3	A61M25/10 A61F2/06
A	DE-A-26 59 238 (OLYMPUS) 1 September 1977 * page 12, paragraph 2 - page 13, paragraph 4; figures 3,5,7 *	1,2	
D,A	US-A-5 226 889 (SHEIBAN) 13 July 1993 * claim 1; figure 1 *	1,4	
A	DE-A-38 33 359 (BOCKENHEIMER) 5 April 1990 * abstract; figure 2 *	1	
P,X	US-A-5 358 487 (MILLER) 25 October 1994 * abstract; figures 1,2 *	1,5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			A61M A61F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 2 February 1996	Examiner Kousouretas, I
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document I : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons & : member of the same patent family, corresponding document			

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